F98

SQUIDs and Noise Thermometers

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Structure

- Physikalische Fragestellung
  - SQUIDs
  - Noise Thermometers
  - kurze theoretische Einleitung
- Messprinzip und Apparatur
- Vorstellung der Messergebnisse und deren Auswertung
- kritische Diskussion der Ergebnisse
- Anmerkung zum Versuch

Physics in Question

- Question: How to measure the temperature of a system using noise.
- Answer: Using a SQUID.
  Very sensitive magnetometers, consisting of superconducting loops interrupted by Josephson junctions.

What we measure and why

1. Resistance at room temperature and in liquid Helium:
   Observe the change in Resistence
2. Current - Voltage characteristics $V - I$:
   Estimate critical current I_C
3. Measure the $V - \Phi$ Characteristics:
   Determine the inverse mutual inductance M_{IN}^{-1} and $M_{\Phi B}^{-1}$
4. Measure output resulting from periodic input signal:
   Determine the amplification
5. Measure Noise at different GBP:
   Finding an optimal value for the GBP
6. Measure Noise Spectrum with a two stage SQUID:
   Calculate the temperature

- Superconductivity

Superconductivity:
Expulsion of magnetic fields from a superconductor below its critical temperature.

- Superconductivity
  - Meissner-Ochsenfeld effect

Meissner-Ochsenfeld Effect:
Expulsion of magnetic fields from a superconductor below its critical temperature.

- Josephson junction

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- Josephson junction
  - Flux quantization

Flux Quantization :

Flux quantization plays a role in the phase relationship between the two superconductors.

- Josephson junction
    - Cooper pairs

Cooper Pairs:

Cooper pairs tunnel through the insulating barrier, causing the Josephson effect.

SQUIDs:

SQUIDs.

- SQUIDs

- SQUIDs
  - DC SQUID

DC SQUID:

A superconducting quantum interference device with two Josephson junctions for measuring magnetic flux.

- SQUIDs
  - Flux locked loop

Flux Locked Loop:
A feedback loop that stabilizes the SQUID output by maintaining constant magnetic flux

- SQUIDs
  - Two-stage SQUID

Two-Stage SQUID:
Enhances sensitivity by using a primary SQUID amplified by a secondary stage.

Takeaways

- dc-SQUIDs can be very sensitive ampfiliers for high precision applications such as:
  - Measuring the CMB in the COBE & PLANCK Satelites.